PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in Corrosion-resistant Alloys

I, HARRY E. LABOUR, of 1214, E. Jackson Boulevard, Elkhart, Indiana, United States of America, a citizen of the United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to alloys, and is directed more particularly to alloys of a generally corrosion resistant nature with respect to caustics and acids, and yet possessing desirable characteristics rendering them adapted to casting, machining, and capable of being readily welded.

In the manufacture of pumps, valves, pipes, pipe fittings and the like for handling chemicals, and solutions of corrosive materials, particularly at elevated temperatures, such as acids, alkalis and the like, it is highly desirable to have a metal of suitable mechanical strength and workability capable of use for such purposes, and yet possessing sufficient resistivity to provide for its use in apparatus of this type without deterioration or corrosion.

The present metal also finds use in the petroleum refining industry, which includes not only the cracking and distillation of crude petroleum into its various constituents, but also the chemical refining of the various petroleum products. In this connection the present alloy may be used in forming valves, valve parts, chemical apparatus and equipment and the like.

The alloy of my invention is the most generally corrosion resistant metal with which I am familiar, in this respect being superior to any of the metals of this type now on the market, and yet can be produced at relatively low cost. It can be readily machined and has no hard spots. In casting it has a peculiarly advantageous characteristic in that it forms a more dense casting than most of the high nickel alloys. In addition to this, it has relatively great mechanical strength, and welds quite freely, being far superior in this respect to most of the alloys in this same general class.

In order to acquaint those skilled in the art with the manner of using the alloy of my invention I shall describe the ingredients and mode of combining the same together with the characteristics of the finished metal.

The alloys according to the present invention contain 50 to 55% nickel, 20 to 30% chromium, 2 to 12% iron, less than 0.3% carbon, less than 1% manganese, up to 7% copper, (usually between 3½ and 7%) up to 5% silicon (usually between 3½ and 5%), up to 6% molybdenum, (usually between 2% and 6%) and up to 3% tungsten, (usually between 1% and 3%).

An analysis of a typical example of the alloy of my invention is as follows, in percentage by weight of the various ingredients:

Nickel	52%
Chromium	23%
Copper	6%
Silicon	4%
Manganese	under 0.6%
Tungsten	2%
Molybdenum	4%
Carbon	0.2%
Iron	8%

The alloy thus contains a relative high percentage of nickel and chromium, a considerably smaller percentage of iron, and still smaller percentages of copper, silicon and molybdenum, with a slight amount of tungsten and minute quantities of manganese and carbon.

The iron used in the production of the alloy is preferably a low carbon steel.

According to a preferred mode of preparing the alloy I proceed substantially as follows:

The furnace is charged with a low carbon steel and chromium is added after the steel is melted and conditioned. The chromium may be employed in the form of ferro-chrome which appears on the market as an alloy of approximately 70% chromium and 30% iron, although a slightly higher percentage of iron may be employed. The copper and nickel may in part be added for convenience and matter of cost as the alloy known under

[*Price* 1/-]

the Registered Trade Mark "Monel," but to bring up the nickel content, which comprises substantially 50% of the alloy ingredients, a portion of the nickel may be added as nickel shot or perhaps as scrap nickel.

After the furnace has been thus charged and the metal becomes molten, it may preferably be kept protected by a slag of any suitable type, and the remaining ingredients necessary to complete the alloy are then added in the proper proportions to produce the final molten charge of alloy. Immediately following the melting of the ingredients and bringing the alloy to the desired pouring temperature, the mass is treated with a scavenger of any suitable or desired type, and the charge is then drawn from the furnace as quickly as possible to be poured into molds. The scavenging agent or agents may be appropriate scavengers capable of eliminating the oxides and included gases, and reducing the sulphur.

The metal is capable of resisting the deteriorating effects of all strengths of nitric acid, phosphoric acid and sulphuric acid, even at elevated temperatures, and is also quite resistant to hydrochloric acid. In this latter connection it has been used successfully in the making of dental plates as a substitute for gold and other of the more noble metals because of its resistance to hydrochloric acids present in the mouth.

The alloy of this invention is capable of taking a high polish, has a smooth finish, and can therefore be employed for impellers, shafting and the like in chemical pumps and associated parts, and also for valves, valve parts and the like which are subjected to mineral acids, fruit acids, organic acids, salts, alkalis or other caustic substances or solutions.

Although the present alloy posesses considerable mechanical strength, having a tensile strength in casting form of approximately 67000 pounds per square inch, and having a yield point and elastic limit of approximately 55000 pounds per square inch, its mechanical strength is not its main advantage and superiority over previous alloys of this general class. The main characteristics which the present alloy possess that render it superior to and a distinct improvement over alloys of this type with which I am familiar is its high general resistance to all types of corrosive compounds, and its applicability as a non-deteriorating metal for use in chemical apparatus such as pumps, valves, pipes, fittings and associated parts.

I consider that within the following ranges of ingredients the desirable and distinct advantages possessed by the alloy of this invention may be attained:

Nickel	50 —55%
Chromium	20 —30%
Copper	3½— 7%
Silicon	3½— 5%
Manganese	under 1%
Molybdenum	2 — 6%
Carbon	under .30%
Iron	2 —12%
Tungsten	1 — 3%

Suffice it to say at this time that the metal having substantially the composition above disclosed is unique in its resistivity to acids, alkalis, and thus to corrosion and deterioration when used as parts of chemical apparatus handling such materials, while at the same time retaining the desirable physical characteristics essential to its employment for pumps, valves, pipes, fittings and associated parts for handling corrosive liquids that are commonly encountered in chemical processes.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A corrosion resisting alloy consisting of the following:

Nickel	50 to 55%
Chromium	20 to 30%
Iron	2 to 12%
Silicon	3½ to 5%
Molybdenum	2 to 6%
Tungsten	1 to 3%
Carbon	under .30%
Manganese	under 1%
Copper	3½ to 7%.

2. A corrosion resisting alloy, the analysis of which exhibits the following composition in per cent. by weight of the various ingredients, namely:

Nickel	52%
Chromium	23%
Copper	6%
Silicon	4%
Manganese	under 0.6%
Tungsten	2%
Molybdenum	4%
Carbon	0.20%
Iron	8%

3. A corrosion resisting alloy having a nickel content of 50% to 55%, a chromium content of 20% to 30%, an iron content of 2% to 12%, carbon less than 0.30%, manganese less than 1%, and the remainder comprising silicon up

to 5%, molybdenum up to 6%, tungsten up to 3% and copper up to 7%.

4. A corrosion resisting alloy as claimed in claim 3 wherein the silicon content amounts to or exceeds 3½%.

5. A corrosion.resisting alloy as claimed in claim 4 wherein the copper content amounts to or exceeds 3½%.

Dated this 28th day of August, 1936.

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